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FOR SEALED SOURCES OF RADIUM 226

P. H. Bedrosian, et al

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IMPROVED PHOTOGRAPHIC LEAK TEST SYSTEM FOR SEALED SOURCES OF RADIUM 226*

By P. H. BEDROSIAN, Ph.D.,† and E. L. SENSINTAFFAR
MONTGOMERY, ALABAMA

TWO photographic methods for leak testing sealed sources of radium 226 have been documented.^{1,2} Both procedures use high-speed photographic emulsion to detect light produced by interactions between a ZnS screen and alpha particles emitted by leaking sources. The Polaroid Land 4×5 film system, which includes individually packeted photographic film and film holder, is used in these methods. The film packet includes its own developing solution, and exposure of the film is made by sliding off the protective packet envelope. Exposure and development of the film is achieved by use of the film holder. For these methods, orientation of the source, ZnS screen, and photographic emulsion required that the source be placed within the source chamber of the device prior to exposing the film. Since the film is usually uncovered manually while

the source is only a few centimeters away in the chamber, unnecessary radiation exposure to the upper part of the body, particularly to the hands and arms of the operator, may occur. While careful handling and good practice may reduce personnel exposure, minimal exposure would occur if the test procedure were reversed, *i.e.*, the film uncovered then the source placed into the chamber. To achieve this, the photographic unit for detecting radon was modified.² The essential aspect of the modification lay in fabricating a device in which the source chamber could remain open to light without fogging the film if it were in the exposed position.* Figure 1, *A* and *B* depicts schematically the main

* As in the other referenced photographic methods, the modified version uses Polaroid Land film Type 57 ASA 3000. Use of the Polaroid equipment does not constitute endorsement by the U.S. Public Health Service.

* From the Department of Health, Education, and Welfare, Public Health Service, Bureau of Radiological Health, Southeastern Radiological Health Laboratory, Montgomery, Alabama.

† Present Address: Environmental Protection Agency, Office of Research and Monitoring, Radiation Research, Research Division, Rockville, Maryland.

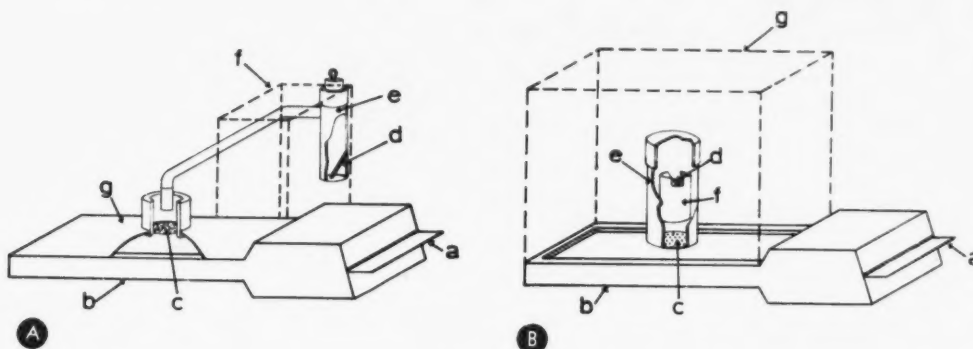


FIG. 1. (A) Diagram depicts modified device which can be loaded with radioactive source while film is in exposed position. (B) Diagram shows unmodified unit which permits film to be exposed only after source is in the capped chamber. a = film and packet; b = film holder; c = phosphor; d = source; e = source chamber; f = lead shield; and g = light tight cover.

components of the device with and without the modification.

The modified unit consists of a bent tube which leads radon from the chamber to the ZnS phosphor. Bends in the tube permit radon to reach the phosphor, but allow essentially no light to reach the film while the source chamber is open. In this manner, the operator leaves the chamber open, uncovers the film and contacts the ZnS face of the window assembly with the film. From a distance, he then places the source into the chamber which is recapped for the test. The movable, 4 inch thick lead shield indicated in Figure 1 serves not only to prevent overexposure of the film but also to protect personnel from radiations produced by the source. After the film has been exposed, the source is removed from the chamber first, then the film is manually processed in complete safety.

The component parts of the improved radon photography device are shown in Figure 1: A; 2; 3, A C; and 4. Although the improvement represents a significant change in the physical assembly of the apparatus as compared to the earlier prototype, the sensitivity remains unchanged. The unit is capable of detecting an average level of about 20 pc of radon in a 24 hour test. Since the photographic technique is essentially a process for integrating light exposure over a period of time, lower detectable levels are attainable by increasing the exposure time. As much as 60 mg. of radium may be used in a 24 hour test with no gamma radiation interference of the photographic emulsion. Curie levels of radium may be tested in a single loading by proper adjustment of the source chamber volume, the shield thickness, and the exposure time. A typical image resulting from this new device is shown in Figure 5. Any image which displays a grainy pattern is indicative of the presence of radon in the system. No image indicates either no radon in the system or radon in quantities less than the detectable limit of the device.

To avoid radium contamination of the source chamber, the test source is placed

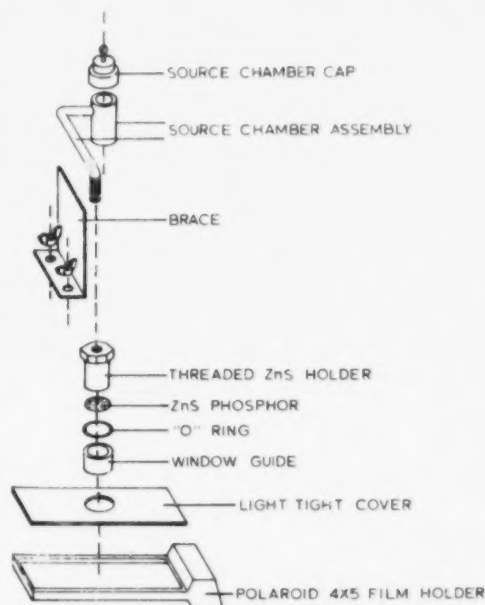


FIG. 2. Exploded view of modified photographic device for leak testing sealed radium sources. Although only one source chamber unit is shown, additional chambers of different sizes may be attached to a single film holder.

in a small disposable container prior to being placed into the chamber. When the ZnS window becomes contaminated by radium daughter products, it may either be replaced or the contaminants allowed to decay to levels not detectable by the photographic unit. Windows may be tested for contamination by exposing them as in leak testing but with no source in the chamber.

SUMMARY

The improved radon photographic method is as rapid as other radium leak test procedures, is more economical and offers more safety to personnel than many of the other techniques.

Testing a 50 mg. radium source by the photographic method usually involves less than 5 mr exposure to the hands when 1 foot or longer handling tools are used in performing the test.

The device is portable and thereby useful

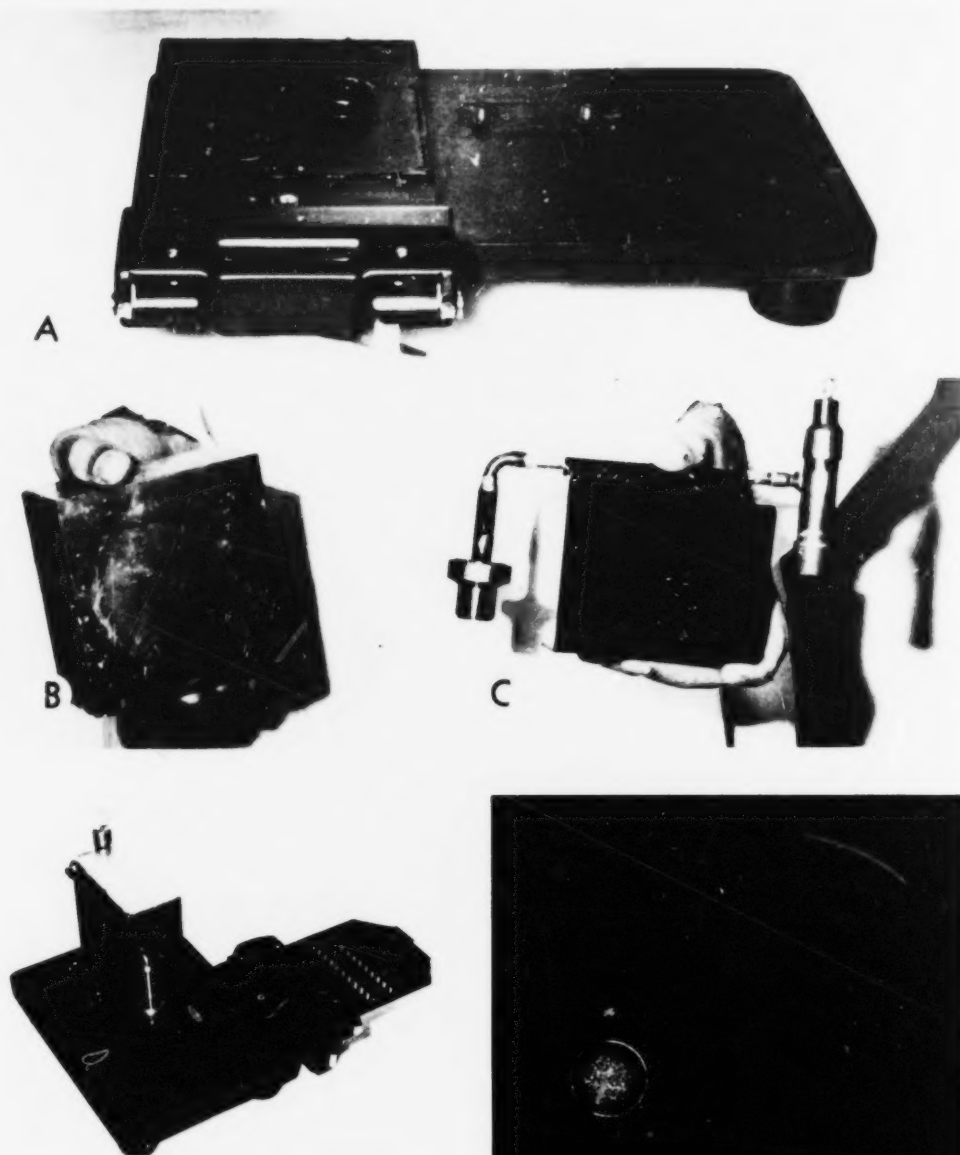


FIG. 4. Top view of the assembled radon photography unit.

FIG. 5. Twenty-four hour exposure of leaking 2.5 mg. radium 226 source results in grainy image as shown in this photograph. Any discernible image of this type indicates presence of radon in the leak test device.

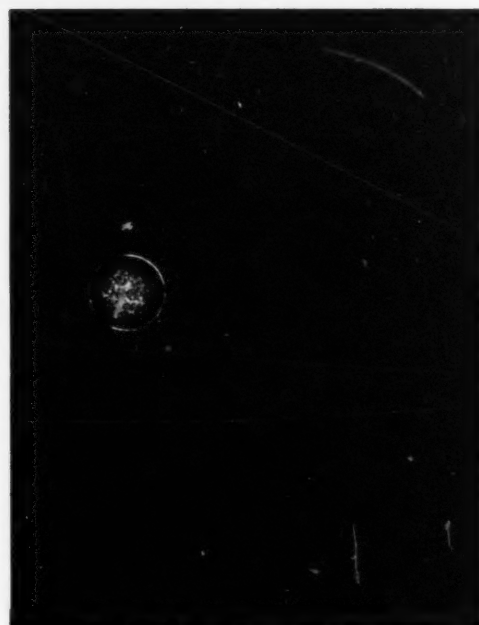


FIG. 3. Major components of the disassembled unit show (A) the mounted film holder; (B) the 4 inch thick lead shield; and (C) the ZnS window-source chamber assembly.

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for field applications. It may be connected to storage safes and calibrated for testing sources while they remain in storage.

Leak testing of large numbers of sources by this technique may be safely done on a daily, weekly, or longer basis.

P. H. Bedrosian, Ph.D.
Environmental Protection Agency
Office of Research and Monitoring
Radiation Research

Research Division
12720 Twinbrook Parkway
Rockville, Maryland 20852

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